Computerized clinical decision support systems (CCDSS) and patient reported outcomes (PRO) - A systematic literature review

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Cancer related symptoms are inadequately managed

Background

- According to a systematic review
  - 64% of patients with incurable cancer reports pain[1]
  - 33% of cancer outpatients are undertreated for pain[2]
- Pain is insufficiently documented in medical records, in one study in only 57% in cancer outpatients[4]
- Implementation of pain guidelines improves pain control in randomized studies[3]

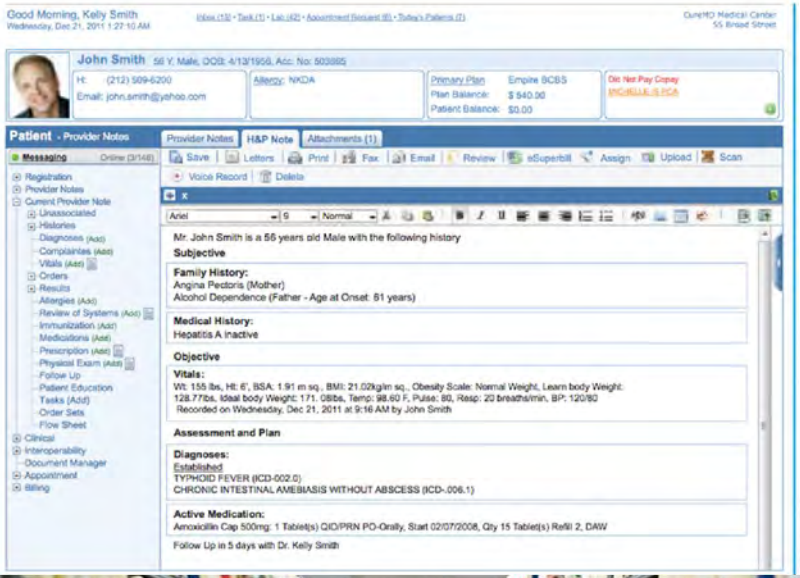
1. van den Beuken-van Everdingen et al, Ann Oncol, 2007
2. Fisch et al, JCO, 2012
3. Du Pen et al, JCO, 2000
4. Cohen et al, JPSM, 2003

Improvements in computer technology

Background

- Rapid development in computer technology
  - Increased processing power
  - Smaller devices
  - Enhanced mobility
- Expanding employment of computers in general
  - Laptops
  - Tablets
  - Smartphones

Background



- Electronic medical records (EMR) introduced in most hospitals in Western Europe and USA
- Several benefits
- EMR is commonly applied to store and retrieve medical data

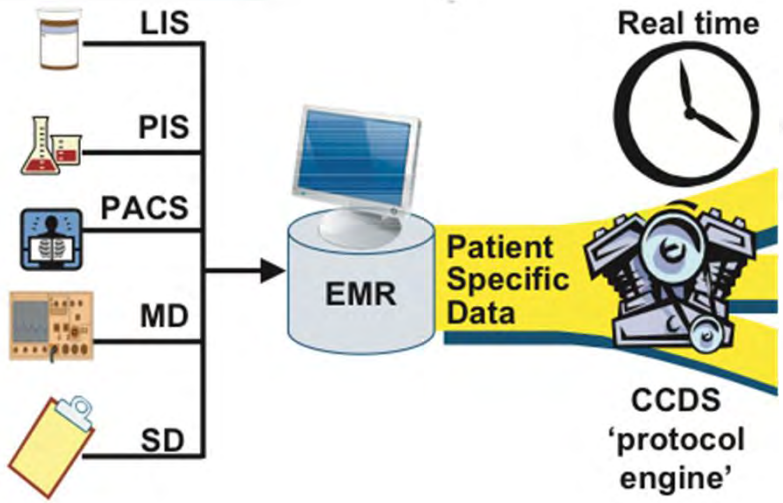
Cancer related symptoms are inadequately managed

Can we improve treatment of cancer related symptoms by applying modern computer technology?

Improvements in computer technology

Computerized decision support systems (CCDSS)

- CCDSS is an elaboration of EMR
- Integrates patient data from various sources
- Several types of CCDSS



Sucher, J Trauma, 2008

Several types of CCDSS

- Alerts and reminder systems
- Order entry systems for prescriptions
- Expert systems

Computer based clinical decision support systems (CCDSS) and patient reported outcomes (PRO), a systematic review

Computer based clinical decision support systems (CCDSS) and patient reported outcomes (PRO) - A systematic literature review

Blum D.[1], Raj S.X.[1], Oberholzer R, Riphagen I.I.[2], Florian S.[2], Kaasa S.[1], EURO IMPACT, European Intersectorial and Multidisciplinary Palliative Care Research Training

Aim of the study

Investigate context, content and application of CCDSS on patient reported outcome

Inclusion criteria

- CCDSS incorporating a clinical guideline
- CCDSS is compared to patient care without a CCDSS
- CCDSS applied by a healthcare professional in a clinical practice
- CCDSS provides treatment recommendations
- Trials investigating patient reported outcomes

Research questions

- In what context is the CCDSS applied?
- How is the flow of data in and out of the CCDSS?
- What guidelines did the CCDSS employ?
- What was the efficacy of CCDSS?

What is patient reported outcome (PRO)?

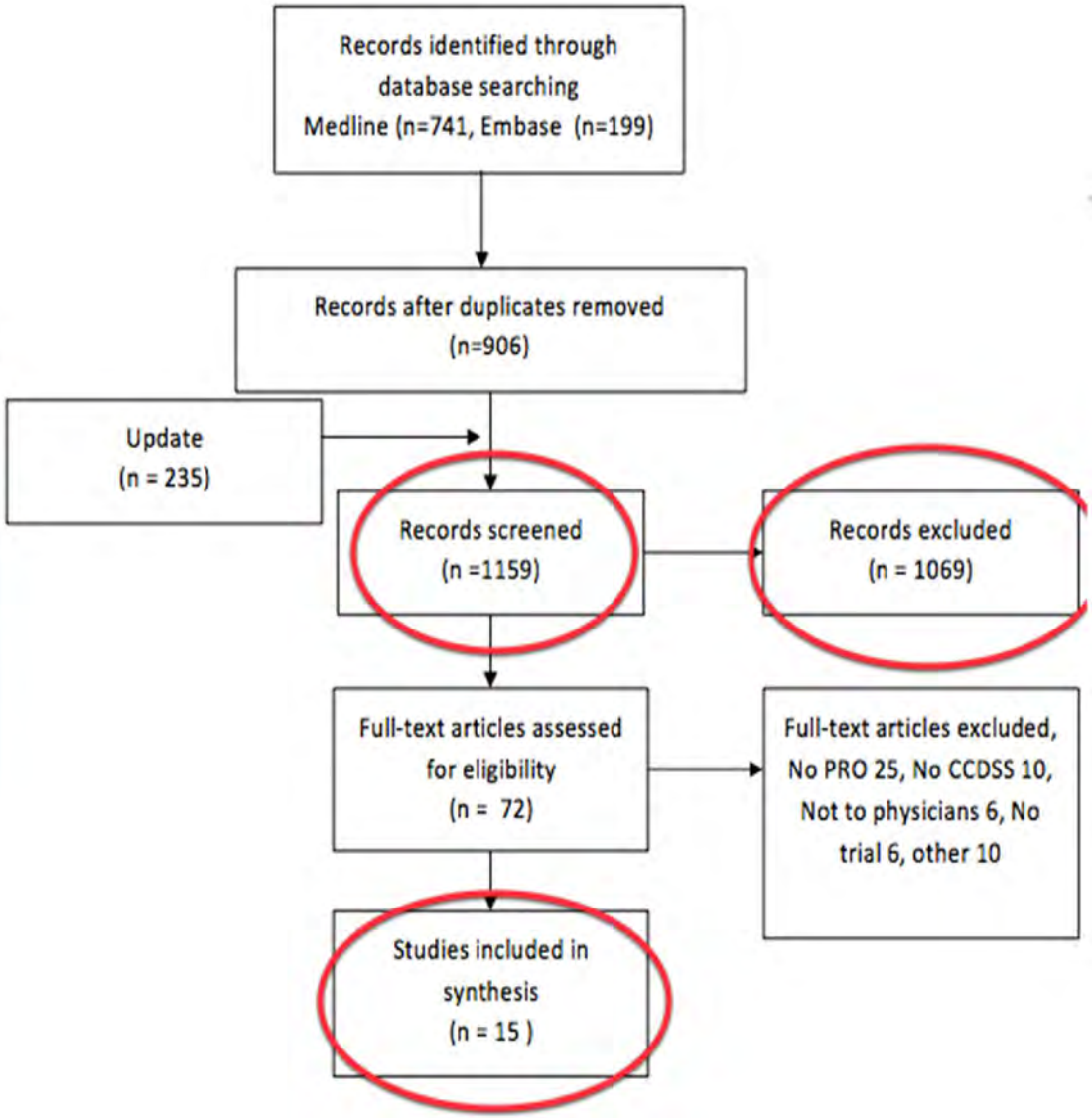
- Information on symptoms reported directly by patients
- Main purpose: Conveying this information to the clinician at point-of-care
- Generic (QoL) and specific (symptoms) PRO
- PRO may improve physician-patient communication[1] and hQoL[2]

1. Takeuchi et al, JCO, 2011
2. Velikova et al, JCO, 2004

Method

- Medline and Embase 1996 – September 2011
- Search terms covered CCDSS and PRO
- Two reviewers screened citations and abstracts independently, disagreements resolved by consensus
- Full text articles retrieved for all potentially relevant articles

Consort diagram



Results

- 15 trials representing 13480 patients were included
  - 10 RCT
  - 5 non-RCT

- Range of included patients per trial was 44 to 4851

In what context is the CCDSS applied?

- 14 trials in outpatient setting

- Diagnosis
  - Lung disease 4 trials
  - Psychiatric disease 4 trials
  - Cardiovascular disease 3 trials
  - Pain treatment 2 trials
  - Primary care 2 trials

How is the flow of data in and out of the CCDSS?

- Data input
  - Patients actively completed data in 7 trials
  - Telephone interview in 2 trials
  - Clinician completed patient data 3 trials
  - Unclear in 3 trials

- Data output
  - Treatment recommendations were delivered to the physician at point-of-care in 11 trials

What guidelines did the CCDSS employ?

- National or regional guidelines were applied in 11 trials, other types of guidelines in the rest of the trials

What was the efficacy of CCDSS?

3 of 15 trials demonstrated significant impact of CCDSS on PRO

Two trials on patients with scizophrenia
One trial on patients with COPD/astma

Table 3 Study-Quality

Author	Design	Allocation concealment	Losses to follow-up	Intention to treat analysis	Rando-mization	Sample size calculation	Industry independent
Kattan	RCT, children were randomized	Yes	5 in the intervention group, 3 in the control group	Yes	Yes	Not described in methods chapter	Yes
Tierny 1	RCT, both clinicians and patients were randomized	Yes, sort of.	74 in group 1, 75 in group 2, 71 in group 3 and 83 in group 4	No. Not stated explicitly	Yes	Yes	Yes
McCowan	RCT	Yes	9 og 16 practices lost to follow up in the intervention group, 12 of 25 in the control group. No statement about the number of patients	No	Yes, both with practices and patients	Yes	No. Practices received grant from Glaxo.
Eccles	Pragmatic cluster RCT using 2 x 2 blocks	Yes, sort of. Practices were randomized.	Two practices in the angina group withdrew from trial after randomization. None in the asthma group.	Yes. Pragmatic intention to treat analysis	Yes, Practices were randomized.	Yes	No, seems like an IT company provided some funds
Tierny 2	RCT	Yes, sort of.	164 of 870 patients were lost to follow up after inclusion	No. Not stated explicitly	Yes	Yes	Yes
Subramanian	RCT, clinicians were randomized	Yes, sort of.	Unclear, not stated in the article	No. Not stated explicitly	Yes	No	Yes
Murray	RCT, 2 x 2 design	Yes, sort of.	91 in group 1, 113 in group 2, 105 in group 3 and 102 in group 4	No. Not stated explicitly	Yes, clinicians and pharmacist	Yes	Yes
Morrison	No RCT Sequential design with study period	Not applicable	Unclear, not stated in the article	No. Not stated explicitly	No	No	Yes
Bertsche	No RCT, but a prospective cohort study with two consecutive study periods	Yes, sort of	Unclear, not stated in the article	Yes	No	Yes	Unclear, the study received grants from a private institution
Rollman	RCT, physicians were randomized	Yes, sort of	10/78 in the intervention group, 9/71 in the control group	Yes	Yes	Yes	Yes
Janssen	No RCT, but three independent study groups located in separate cities	Yes, sort of	4% in Dusseldorf (intervention) and 8% in Freiburg (control) and none in Munich (control)	No	No	Yes	Yes
Schmidt Kraeppelin	Non-Randomized controlled intervention study	No	11% in the intervention group, control group not specified	Yes, probably	No	No	Unclear, not stated in the article
Thomas	RCT	Yes	79% follow up rate in the control group and 70% in the intervention group (p=0.006)	No	Yes	Yes	Yes
Holbrook	Pragmatic randomized trial	Yes	29/253 in the intervention group, 37/258 control group	Yes	Yes	Yes	Yes
Nader	No RCT, sequential study with two study groups	Yes, sort of	98% follow up rate	No, no stated explicitly	No	No	Yes

Results – positive studies

- Outpatients with schizophrenia. N=522.
- In the intervention group a CCDSS was connected to EMR and national guidelines
- When a predefined constellation of symptoms occurred, a treatment advice was displayed on the physician's computer.

- Significant efficacy on positive symptoms applying CCDS (p=0.004)
- Lower amounts of rehospitalization applying CCDSS (p=0.016)

Jansen et al, Eur Arch Psych Clin Neurosci, 2010

CCDSS quality

- Key factors for successful CCDSS systems have been identified[1-2]:
  - Patients fill inn data
  - Decision support at point-of-care
  - CCDSS system integrates with EMR

- All included trials were reviewed for these key factors

1. Delpierre et al, Int J Qual Health Care, 2004
2. Kawamoto et al, BMJ, 2005

CCDSS quality

- 7 trials fulfilled all three criteria
- Of the 3 trials with a positive impact of CCDSS on PRO
  - Only one fulfilled all three criteria
  - Two other studies fulfilled 2 of 3 criteria

CCDSS quality

- In a recent published meta-regression analyses of randomized controlled trials the following criteria defined effective CCDSS[1]
  - Clinician provide reason for not accommodating to an advice
  - Offer advice concurrently to both practitioners and patients
  - CCDSS evaluated by the developers of the CCDSS
- None of the positive trials fulfill these criteria

1. Roshanov, BMJ, 2013

Discussion

- Only 3 out of 15 trials demonstrated significant efficacy of CCDSS on PRO

- Trials in psychiatric disease may be more likely to be positive
- Data entry requirements for clinicians time consuming[1]
- Clinicians have mistrust in CCDSS and guidelines[2]

- 1. Tierny et al, J Gen Intern Med, 2003
- 2. Murray et al, Pharmacotherapy 2004

Limitations

- We applied a narrow definition of CCDSS
- We focused on PRO, not clinical outcomes. Many studies are designed to detect differences in clinical outcome rather than PRO
- Due to the great variability of studies and outcomes, meta-analysis of the data was not possible

Conclusion

- Limited evidence that CCDSS improve PRO

- We need to improve CCDSS
  - collaboration of patients and clinicians in developing CCDSS
  - simplified methods of data entry for clinician
  - tighter integration with EMR
  - providing decision support with research data
  - reason to override a decision support
  - CCDSS systems that also provide advice for patients

Author/Year	Patients fill inn data	Data presented to care-taker at point of care	Integrates with electronical medical journal	Number of criteria fulfilled
1Kattan 2006	No	No	No	0/3
2 Tierny 2005 Health-Serv-Research	Unclear, but probably no	Yes	Yes	2/3
3 McCowan 2001 Medical-Infor	Yes	Yes	Yes	3/3
4 Eccles 2002 BMJ	Yes	Yes	Yes	3/3
5 Tierny 2003	No	Yes	Yes	2/3
6Subramanian 2004 Am-J-Med	Yes	Yes	Yes	3/3
7 Murray 2004 Pharmacotherapy	Yes, but unclear how patients fill inn data	Yes	Yes	3/3
8 Morrison 2006 Ann-Int-Med	Yes	Yes	Yes	3/3
9 Bertsche 2009 Pain	No	No	No	0/3
10 Rollman 2002 J-Gen-Int-Med	No	Yes	No	1/3
11 Janssen 2009 Eur-Arch-Psych-Clin-Neurosc	No	Yes	Yes	2/3
12 Schmidt Kraeppelin Eur-Arch-Psych-Clin-Neurosc 2009	No	Yes	Yes	2/3
13 Thomas 2004 Br-J-Gen-Prac	Yes	Yes	No	2/3
14 Holbrook 2009 CMAJ	Yes	Yes	Yes	3/3
15 Nader 2009 AIDS patients care STDS	Yes	Yes	Yes	3/3